

NORTH ATLANTIC STORMS FOR MARCH, 1888.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

The paths of the depressions that appeared over the north Atlantic Ocean during March, 1888, have been determined from international simultaneous observations by captains of ocean steamships and sailing vessels, received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Of the seven depressions traced, two, numbers 3 and 6, first appeared east of the twentieth meridian and occasioned severe storms over the British Isles during the second and third decades of the month. Over the western portion of the ocean the weather was very severe during the first and second decades, attending the presence of depressions numbers 1 and 4, which were remarkable alike for their great strength and by reason of their irregular movements. Of the remaining depressions, number 5, alone, evidenced marked energy.

In March, 1887, eleven depressions were traced, the tracks largely predominating to the southeastward and southward of Newfoundland and Nova Scotia, where their rate of progression was, in general, slow, and their course of movement greatly diversified. During the first two decades of the month the more important storms which appeared were confined to the western half of the ocean, where deep barometric depressions, accompanied by storms of great violence, followed one another in rapid succession. During this period the barometric pressure over the eastern portion of the ocean remained almost continuously high, with generally settled weather. During the last decade of the month cyclonic areas traversed the ocean from coast to coast, and the region of greatest storm frequency was included within an area extending from the east edge of the Banks of Newfoundland to the west coasts of the British Isles.

As compared with the corresponding month of previous years, the depressions traced for March, 1888, were deficient in number, and, as a whole, in energy. The severe weather which prevailed west of the fortieth meridian from the 12th to the 16th, inclusive, and over the British Isles and adjacent ocean during portions of the second and third decades, constituted noteworthy features, and the destructive character of the storms of those periods may be attributed rather to their persistence than to exceptional energy on the part of the depressions which they attended. A characteristic of the four important depressions which appeared, numbers 1, 3, 4, and 6, was the extreme irregularity and slowness of their progressive movement, which resulted in an unusual continuation of gales and high, confused seas in the regions in which they prevailed.

In the following descriptions of the depressions traced, their abnormal features will be considered in connection with the general meteorological conditions which existed over the ocean during their prevalence:

1.—This depression was central on the 1st off the southeast edge of the Banks of Newfoundland, and during the five following dates pursued a diversified course over or near the Grand Banks; subsequent to the 6th the centre of depression moved east-northeast, and disappeared over the British Isles after the 11th. On the 1st barometric pressure falling to about 29.10 (739.1) was shown in N. 42°, W. 45°, and strong to whole gales prevailed between the thirtieth and fiftieth meridians. By 12 noon, Greenwich time, of the 2d the storm-centre had advanced northeast to the forty-fifth parallel, and a subsidiary depression was apparently central over Newfoundland. To the eastward of the twentieth meridian, and off the coast of the United States, the pressure rose above 30.30 (769.6). By the 3d the centre of depression had recurved southwest to N. 42°, W. 47°, with barometric minimum below 28.80 (731.5). As no secondary depression appeared on this date, it is assumed that the one indicated over Newfoundland on the 2d had moved southeast and united with the principal area of low, and it is not improbable that the presence and advance from the westward of this secondary low contributed, together with the high barometer which prevailed over the eastern part of the ocean, to impart the abnormal southwest course assumed by the de-

pression from the 2d to the 3d. By the 4th the centre of disturbance had moved westward to the fifty-fifth meridian, with slight changes in barometric minima. On this date the pressure was high east of the thirtieth meridian, while along the coast of the United States the barometer readings were somewhat lower than on the preceding date. Subsequent to the 4th the depression moved eastward, and from the 5th to the 11th, inclusive, followed a normal track to the British Isles, attended throughout by pressure falling below 29.00 (736.6), and strong to whole gales.

2.—This was an unimportant though well-defined depression which moved eastward along or near the fortieth parallel, between the fortieth and sixtieth meridians, from the 10th to the 12th, inclusive.

3.—This depression was central on the 12th in N. 52°, W. 19°, whence it had advanced from the northwest. On this date central pressure about 29.10 (739.1) was shown, and fresh to whole gales prevailed east of the thirty-fifth meridian. At noon, Greenwich time, of the 13th the depression was central off the southwest coast of Ireland, and during the next twenty-four hours moved slowly eastward over Ireland, with minimum pressure about 29.10 (739.1). By the 15th there was no appreciable change in the position or included barometric readings of the depression. By the 16th the storm-centre had moved east or south of east, and a rapid increase in pressure and fresh northerly gales occurred over the British Isles.

4.—A history of the depression of which this storm was the continuation is given in detail under the heading "Areas of low pressure."

On the 14th the storm was central in N. 42°, W. 58°, with minimum pressure about 29.40 (746.7). On this date a steep barometric gradient existed eastward to the fortieth meridian and northeastward to Newfoundland, where the pressure rose above 30.10 (764.5). To the westward of the principal storm-area, and in close proximity to the American coast, the presence of a subsidiary area of low was indicated. By the 15th the depression southeast of Nova Scotia on the 14th had recurved two degrees to the westward, this abnormal movement being evidently due to the presence to the eastward and northeastward of an area of relatively high pressure, whereby its eastward progress was obstructed, and as a contributory cause the attraction offered by the approach from the westward of the secondary depression, with which it united, may be considered. Subsequent to the 15th the depression pursued a normal east-northeast to northeast track and disappeared north of the region of observation, in the vicinity of the twenty-fifth meridian, after the 19th; its passage being attended during the 16th and 17th by pressure falling below 29.00 (736.6), after which a marked loss of energy was apparent.

The following special reports show the general character of disturbances which attended the passage of this depression on the ocean:

Captain Klinkshel, of the s. s. "Andes," reports: "March 11th, 4 a. m., wind se., force 4, increasing to 6; barometer, 30.32 (770.1) and falling. Noon, in N. 31° 19', W. 73° 43', wind very unsteady; barometer, 30.01 (762.2); 4 p. m., wind sse., increasing and squally; barometer, 29.99 (761.7); air, 54°; 8 p. m., wind blowing a gale and increasing; barometer, 29.57 (751.1); 9 p. m., barometer, 29.35 (745.5), lowest; air, 54°; 10 p. m., wind, sse., strong gale, increasing and heavy sea from se.; 11 p. m., wind died out and for ten minutes there was a dead calm with sky very dark and threatening; very heavy squalls of rain; barometer steady at 29.35 (745.5); the wind then jumped out from wnw. and blew with hurricane force; barometer commenced to rise and at midnight was 29.61 (752.1) and rising rapidly. March 12, 4 a. m., wind nw., hard gale with a tremendous heavy sea and fierce squalls; barometer, 29.61 (752.1); air, 54°; gale continued with unabated force; 6 a. m., barometer, 29.63 (752.6); noon, very heavy gale and sea; sky covered; barometer rising, N. 34° 20', W.

73° 42'; 6 p. m., wind still nw. but moderating; barometer, 29.93 (760.2), weather unsettled; the wind continued to decrease in force and the barometer to rise until midnight, when it stood at 29.96 (761.0). It then commenced to fall slowly and the wind increased to a moderate gale and continued squally and unsettled throughout March 13th, in N. 36° 21', W. 73° 36', at noon. High westerly winds and squally weather continued until 10 p. m., March 14th, then fine weather throughout the remainder of the passage." Captain Cates, of the brig "Arcot," reports: "March 12th, laying off Five-fathom Bank Lightship, Capes of Delaware, in easterly storm and bad cross sea, ne. and ese.; barometer, 29.20 (741.7). At 1 a. m., local time, was struck by a violent hurricane from the nnw., accompanied by blinding snow, completely overwhelming the vessel in the wild confused sea, and blew the sea half-mast high. Bore off before the gale which blew at the rate of eighty to ninety miles an hour for twenty-four hours, accompanied with snow and hail all the while. March 13th, wind backed to nw. by w., whole gale, with heavy squalls of hail and rain, lasting forty-eight hours."

Captain Aitkenhead, of the brig "Arcot," reports: "March 13th, in N. 37° 57', W. 63° 02', gale commenced from nw., force 8; noon, w., force 8, barometer 29.48 (723.4). March 14th, in N. 39° 05', W. 65° 10', wind hauled to nw. by n., force 8, and continued till 5 p. m., force 7-8, barometer at noon 29.43 (747.5). March 15th, in N. 39° 40', W. 67° 17', gale continued from ne. to n. by e., force 9-10, and then moderated, barometer 29.61 (752.1)." Captain Pitt, of the s. s. "Brooklyn City," reports: "March 13th, 9 p. m., 75th meridian time, in N. 40° 48', W. 64° 20', barometer 29.19 (741.1), (lowest). March 16th, 3 p. m., gale set in from w. to wsw., highest force 10, lowest barometer 28.69 (728.7), position N. 43° 10', W. 50° 40'." Captain Sullivan, of the New York pilot boat "Caprice," reports: "March 11th, midnight, calm, overcast, dark, and gloomy, with steady fall of heavy rain, barometer 29.80 (756.9). March 12th, 4 a. m., wind came out suddenly from nne., a moderate gale, barometer 29.70 (754.1), vessel about 33 miles se. of Sandy Hook; from 5 to 6 a. m. wind n., increasing in force; 6 a. m. blowing a hurricane from nnw., barometer oscillating between 29.60 (751.8) and 29.70 (754.4), high cross sea from se. and ne., snowing, and blowing spray; 8 a. m., barometer 29.50 (749.3); lowest barometer, 29.20 (741.7), at noon of the 12th; gale commenced to moderate at 11 a. m. of the 13th, with rising barometer." Captain Catharine, of the s. s. "City of Augusta," reports a gale of force 10 on the 11th and 12th, wind veered from se. to s. and nw., lowest barometer, 29.35 (745.5), at 1 a. m. of the 12th, in N. 35°, W. 75° 20'. Captain Henderson, of the s. s. "Colon," reports a severe gale on the 11th, wind veered suddenly from se. to w. and nw., very heavy confused sea, heaviest from the northward, barometer 29.60 (751.8) at 11.03 p. m., in N. 35° 20', W. 74° 00'. Captain Hedderwick, of the s. s. "Furnessia," reports a gale of force 11 on the 12th and 13th, wind shifted to from n. to nnw. and nw., barometer 29.26 (743.2) at 7.45 a. m., in N. 39° 24', W. 71° 47'. Captain Urquhart, of the s. s. "Lord Clive," reports a hurricane on the 12th; wind veered from ese. to sw. and nw., with tremendous high and cross seas, barometer 29.21 (741.9) at 11 a. m., in N. 39° 14', W. 72°.

Captain Haggett, of the s. s. "Lydian Monarch," reports a gale of force 11 on the 13th; wind set in from sw., shifting to se., s., and sw.; barometer 29.05 (737.9) at 5 p. m., in N. 40° 30', W. 66° 50'. Captain Higgins, of the schr. "Lida Fowler," reports: "13th, 8 a. m., barometer, 29.39 (746.5); snow; noon, N. 38° 00', W. 70° 10'; moderate westerly winds; occasional snow squalls; 8 p. m., moderate nw. gale; barometer, 29.59 (751.6); 14th, barometer, 29.79 (756.7); light breeze from nnw.; 4 p. m., fresh nnw. gale; midnight, barometer 29.79 (756.7); strong gale. During the 15th, strong gale, wind backing to sw., then out to nw.; rising barometer." Captain Elliott, of the s. s. "Nessmore," reports a heavy gale on the 13th and 14th; wind shifted suddenly in fierce squalls into the s., se., sw., and wsw., with raging cross seas from every point of the compass; low-

est barometer, 29.10 (739.1), at noon of the 13th, in N. 39° 48', W. 60° 45'. On the 16th, in N. 42° 43', W. 43° 31', at 5.55 p. m. a gale set in from the sw. and veered to w. and nw.; highest force 10; lowest barometer, 28.73 (729.7). Captain Fry, of the s. s. "City of Lincoln," reports a gale of force 10 on the 14th and 15th; wind set in from wsw. and shifted to wnw.; lowest barometer, 29.51 (749.5), at 8.48 p. m. of the 14th, in N. 31° 44', W. 63° 38'. Captain Brunn, of the s. s. "Fædrelandet," reports: "14th, 1 a. m., in N. 33° 30', W. 75° 05', barometer 29.72 (754.9); between 4 and 8 a. m. the air had a very ugly appearance, stormy-looking, with numerous small water-spouts, and masses of dripping fog." Captain Meyer, of the bark "Johanna," reports: "14th, in N. 33° 51', W. 73° 20', n. to nw. gale, at times of hurricane force, continued all day." Captain Fletcher, of the schr. "Melissa Trask," reports: "14th, in N. 34° 20', W. 72° 20', at noon, barometer, 30.23 (767.8), wind, nnw. gale with confused sea." Captain Thompson, of the s. s. "Stockholm City," reports a gale on the 13th: wind set in from e. by n., and ended from s.; lowest barometer, 29.23 (742.4), in N. 42° 25', W. 64° 40'.

5.—The presence of this depression about two degrees northwest of Bermuda was shown by reports of the 18th, on which date pressure falling to 29.50 (749.3) was reported in that locality. Moving rapidly northeast the storm was central on the 19th over the Banks of Newfoundland, with pressure somewhat lower than on the preceding day, and strong to whole gales over a limited area. By the 20th the depression had moved eastward six degrees, with a marked increase in pressure, after which it apparently dissipated.

6.—From the 22d to the 25th, inclusive, the winds along the west-central coast of Europe were cyclonic, and the barometer fell steadily. At noon, Greenwich time, of the 26th the pressure was slightly below 29.00 (736.6) off the southern coasts of the British Isles, and the presence of a storm-centre south of Ireland was indicated. By the 27th the centre of depression had moved eastward toward the French coast, with a slight increase in pressure. By noon of the 28th the storm had recurved southwestward to N. 47° 30', W. 9° 30', with minimum below 28.80 (731.5), from which position it moved eastward over northwestern France during the 29th, with pressure about 28.70 (729.0), and disappeared over the North Sea. This depression apparently originated east of the tenth meridian, and while marine observations admit of approximately defining its path from the 26th to the 29th, inclusive, its history previous and subsequent to the period embraced by those dates cannot, at present, be determined, owing to an absence of reports from European land stations.

7.—This was a depression of moderate energy which moved eastward over Newfoundland during the 30th, and advanced east-southeast along the northern edge of the Grand Banks during the early morning of the 31st; its passage being unattended by noteworthy features.

OCEAN ICE.

On chart i the positions of icebergs and field ice reported during the month are shown by ruled shading. The following report of ice movements at Saint John's, N. F., has been made by Mr. Jno. Higgins, observer at that point: "Ice closed in on the land on the 4th and 5th, driving off on the 6th; 9th, harbor blocked with ice, which extended as far as the eye could reach; 10th to 16th, harbor blocked with ice; 19th, ice driving in again; 25th, ice driving off slowly; 26th, ice packed in on the land; 30th, ice driving off fast." On the 1st the s. s. "Oregon" rounded the southernmost point of field ice in N. 46° 38', W. 47° 26', and in N. 47° 23', W. 46° 56' passed field ice and several large pieces. 2d, s. s. "Chateau Leoville" passed ice fields and pieces of ice in N. 43° 50', W. 52° 10'. 3d, s. s. "Portia" reported field ice along the southeast coast of Newfoundland and the northeast coast of Cape Breton and Saint Pierre. 13th, s. s. "Colima" passed two ice floes and field ice in N. 44° 18', W. 59° 26'. 16th, s. s. "Vancouver" encountered field ice

from N. 43° 56', W. 56° 02' to Chebucto, N. S. 22d, heavy close-packed ice moved south off Saint John's, N. F. 22d, s. s. "Milanese," in N. 42° 30', W. 50° 37', saw field ice to the northward; s. s. "Panama," Cape Race bearing twenty miles northwest, passed an enormous iceberg and a large ice-field. 29th, heavy close-packed ice moved south off Saint John's N. F. While the general drift of the ice reported off Newfoundland was southerly, during the prevalence of strong easterly winds in the middle portion of the month it packed in close to the shore, blocking vessels until dispersed by westerly winds. Interspersed with the field ice many icebergs were observed. As compared with February, 1888, field ice was reported about two degrees farther south, while the eastern limit was over one degree farther west.

Compared with the record for corresponding months of previous years, the quantity of ice reported for March, 1888, was greatly deficient; the southernmost ice encountered was about one and one-half degrees north of the average southern limit, and the easternmost ice was more than three degrees west of the average eastern limit. Reports do not show that a general breaking up of ice massed along the Labrador coast had occurred by the close of the month, or that vessels had effected the passage of Belle Isle Strait, which facts indicate an unusual delay in the annual southern movement of the Arctic ice-fields.

The following table shows the southern and eastern limits of the region within which icebergs or field ice were reported for March during the last six years:

Southern limit.			Eastern limit.		
Month.	Lat. N.	Long. W.	Month.	Lat. N.	Long. W.
March, 1882	42 30	50 00	March, 1882	46 30	46 00
March, 1883	41 46	49 48	March, 1883	48 40	43 03
March, 1884	41 20	54 06	March, 1884	45 00	40 15
March, 1885	40 55	49 04	March, 1885	45 57	43 15
March, 1886	40 20	49 02	March, 1886	47 20	44 40
March, 1887	41 00	49 07	March, 1887	45 31	42 56
March, 1888	42 30	50 37	March, 1888	47 23	46 56

FOG.

The limits of fog-belts to the westward of the fortieth meridian are shown on chart i by dotted shading.

As compared with the chart for February, 1888, the limits of the Newfoundland fog-belt have extended about two degrees southward and eastward, and the number of days during which fog prevailed, sixteen, was one less than the aggregate number of foggy days reported for the preceding month. To the westward of the Grand Banks fog was less frequently encountered, and the southern limit was about the same, except along the coast, where it was about three degrees farther north than in February. With the exception of the 27th and 28th, when northeast winds and high barometer prevailed, the development of fog near Newfoundland attended the approach or passage of cyclonic areas. On the six days for which fog was

reported between the fifty-seventh and sixty-fifth meridians, cyclonic areas were central either to the southeast of Nova Scotia or over the Gulf of Saint Lawrence. On the six dates during which fog prevailed along the coast of the United States, the winds were south to east, with falling barometer, except in one instance, when they were northwesterly. A study of the meteorological conditions which attended the development of fog west of the fortieth meridian during March, 1888, shows its dependence upon the cyclonic circulation of winds. In this, as in all preceding months for which fog reports have been received, an observable feature is the almost absolute certainty with which the presence of fog can be anticipated in the vicinity of Newfoundland, following a shift of wind to the south and east quadrants, with the approach of an area of low barometric pressure; its disappearance, with west to north winds, consequent upon the advance of a cyclonic area to the eastward of the Banks, is in a like degree observable.

The following are the limits of fog-areas on the north Atlantic Ocean during March, 1888, as reported by shipmasters:

Date.	Vessel.	Entered.			Cleared.		
		Lat. N.	Lon. W.	Time.	Lat. N.	Lon. W.	Time.
3	Fog at Saint John's, N. F.	38 12	74 28	4 a. m.	37 03	74 56	9 a. m.
3	S. S. State of Texas	43 32	50 05	6 p. m.	44 04	48 08	2 a. m.
4-5	Fog at Saint John's, N. F.	41 30	50 53	6.24 a. m.	41 30	50 01	
5-6	S. S. Duke of Buckingham	42 32	65 00		42 27	63 50	
13	S. S. Rugia	42 20	60 30		42 18	59 54	
14	S. S. Stockholm City	41 47	47 56	10.12 a. m.	42 07	46 35	6.06 p. m.
15	Fog at Saint John's, N. F.	44 42	51 17	11 p. m.	43 48	55 21	9 a. m.
15	S. S. Oxford	43 15	49 20	2.46 a. m.	42 54	50 13	7.15 a. m.
15-16	S. S. LaBourgonne	43 15	49 20	9 p. m.	43 17	48 40	11 p. m.
16	S. S. Servia	43 50	49 25		44 10	47 58	
16	S. S. Brooklyn City	40 39	46 44	9 p. m.	40 40	46 31	10 p. m.
18	S. S. Stockholm City	42 20	69 00		42 20	70 20	8 p. m.
21	S. S. Pennland	40 45	47 50	10 a. m.	40 40	48 15	2 a. m.
21	S. S. Eider	42 20	52 40	Midnight	43 08	51 53	
21-22	S. S. Persian Monarch	40 45	47 50		41 03	47 37	5.28 a. m.
22	S. S. Thingvalla	41 17	47 07	2.58 a. m.	43 10	52 00	Noon.
22	S. S. Indiana	44 19	46 04	8 p. m.	43 10	54 25	
22-23	S. S. Australia	42 11	53 57	11 p. m.	43 40	51 00	6 p. m.
22-23	S. S. Buffalo	47 30	42 15	4 p. m.	41 45	64 20	7 p. m.
22-24	S. S. Alcides	41 50	63 00	9.30 a. m.	42 20	57 32	10.30 a. m.
22-24	S. S. Bothnia	42 24	57 06		42 10	50 00	
23	S. S. LaBretagne	42 00	49 46	8 a. m.	43 00	52 00	8.32 a. m.
23-24	S. S. Norwegian	45 30	45 00	Noon	43 22	51 33	7 p. m.
23-24	S. S. Lake Ontario	46 26	44 10		48 32	41 58	
24	S. S. State of Nebraska	47 19	43 27	8.33 a. m.	43 06	50 47	11.08 p. m.
24	S. S. Thingvalla	43 43	48 17		40 34	48 16	11.45 a. m.
24	S. S. Italy	40 28	48 48	8 a. m.	40 33	71 51	4 a. m.
24	Fog at Saint John's, N. F.	40 13	71 57	8 a. m.	43 20	50 22	8.15 p. m.
24	S. S. Mareca	43 38	48 36	3.30 p. m.	43 20	50 22	
26-28	Bg. Energy	40 35	74 35	9 a. m.	45 24	43 19	
27	S. S. Republic	36 25	72 20	3 p. m.	40 39	68 49	7.52 p. m.
27-28	S. S. City of Washington	46 08	40 31	10 p. m.	42 23	70 35	3.30 p. m.
27-28	S. S. Lorenzo D. Baker	46 08	40 31	10 p. m.	40 28	72 20	
28	S. S. LuChampagne	45 30	42 55	3.34 a. m.	40 17	72 26	12.50 p. m.
28	do	41 07	66 15	9.50 a. m.	41 03	65 04	
28	S. S. Italy	42 22	66 11	4.20 a. m.	41 40	63 10	1.50 p. m.
28	S. S. Iowa	40 25	65 22	10.30 a. m.	42 31	50 56	2 a. m.
28-29	S. S. Waesland	40 25	65 22	10.30 a. m.	41 11	50 23	2.30 a. m.
28-29	S. S. Lorenzo D. Baker	40 22	70 59	6.13 a. m.			
29	S. S. Italy	41 06	64 00				
29	S. S. Zealandia	41 50	61 45	8 a. m.			
29	S. S. Republic	41 06	49 05	1 a. m.			
29	S. S. British Princess	42 46	49 29				
30	S. S. Erin	41 17	49 54	0.30 a. m.			
30	S. S. Vaderland						

TEMPERATURE OF THE AIR (expressed in degrees, Fahrenheit).

The distribution of mean temperature over the United States and Canada for March, 1888, is exhibited on chart ii by dotted isothermal lines. In the table of miscellaneous data are given the monthly mean temperatures, with the departures from the normal, for the various stations of the Signal Service. The figures opposite the names of the geographical districts in the columns for mean temperature, precipitation, and departures from the normal, show respectively the averages for the several districts. The normal for any district may be found by adding the departure to the current mean when the departure is below the normal, and subtracting when above.

March, 1888, was colder than the average over nearly the

whole country, and in the northern districts from the Lake region westward to the Rocky Mountains the month was comparatively a remarkably cold one, the monthly mean temperatures ranging from 4° to 10° below the normal; a marked departure from the normal temperature also occurred in the middle and southern Rocky Mountain slopes. In the other districts, where the temperature was below normal, the departures were not marked. In the extreme northern portion of New England and the adjacent Canadian Provinces the month was considerably warmer than the average; the contrast between the temperature conditions of these districts and those lying immediately to the westward forms a noteworthy feature, Albany, N.